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CONDITION OF EXPERIMENTAL CHESTNUT POLES IN THE WARREN-BUFFALO AND POUGHKEEPSIE-NEWTON SQUARE LINES AFTER FIVE AND EIGHT YEARS' SERVICE.

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CONTENTS.

	Page.
Purpose of the circular	5
Experimental poles in the Warren-Buffalo line	5
Preparation	5
Placement in line	6
Method of inspection	8
Computation of data	9
Condition of the experimental poles	9
Experimental poles in the Poughkeepsie-Newton Square line	11
Summary of results of inspection of experimental poles	12
Poles in Warren-Buffalo line	12
Poles in Poughkeepsie-Newton Square line	13

ILLUSTRATIONS.

		Page.
FIG. 1.	Condition of experimental poles 5 years after placement	10
2.	Condition of experimental poles 8 years after placement	11

CONDITION OF EXPERIMENTAL CHESTNUT POLES IN THE WARREN-BUFFALO AND POUGHKEEPSIE-NEWTON SQUARE LINES AFTER FIVE AND EIGHT YEARS' SERVICE.

PURPOSE OF THE CIRCULAR.

Forest Service Bulletin 84, "Preservative Treatment of Poles," describes experiments made by the Forest Service concerning the effect of the seasoning and preservative treatment of poles upon their durability. This circular, which supplements it, gives the results of inspections of two experimental lines five and eight years, respectively, after their establishment.

The two lines, built in cooperation with the American Telephone and Telegraph Co., are known as the Warren-Buffalo line and the Poughkeepsie-Newton Square line. In the former are 1,164 30-foot chestnut poles, set between Warren, Pa., and Dayton, N. Y.; in the latter are 72 30-foot chestnut poles, set near Flanders and Morris County Junction in northern New Jersey.

EXPERIMENTAL POLES IN THE WARREN-BUFFALO LINE.

PREPARATION.

The experimental poles for the Warren-Buffalo line were cut and peeled during 1902 and 1903, and delivered at stations near Thorndale, Pa., and Dover, N. J., where they were placed in single tiers on skids about 2 feet above the ground to season. In June and July, 1905, some were butt treated with various preservatives by the brush method, and others with coal-tar creosote by the open-tank method. The following extract from Forest Service Circular 104, "Brush and Tank Pole Treatments," by Carl G. Crawford, describes the two methods of treatment:

Brush treatment.—It is generally conceded that the portion of a pole most subject to decay is that between 2 and 8 feet from the butt—about 20 square feet. This part fails when the remainder is still in a good state of preservation. It was therefore selected for treatment.[1] When the pole is set the treated portion extends 2 feet above and 4 feet below the surface of the ground. From one to three coats were applied, according to directions received from the manufacturer. Most of the preservatives were heated to a temperature of

[1] It is believed at the present time that more satisfactory results will be secured by treating the entire butt to a height of from 1 to 2 feet above the ground line.

from 150° to 175° F. Particular attention was paid to filling all checks and knot holes and to working the preservative into the wood, thus protecting against decay those parts most subject to attack. Careful notes were made of the condition of the poles as regards checks, knot holes, etc. The amount of preservative absorbed by each pole was accurately determined by recording the weight of the preservative before and after each treatment. The temperature of the preservative both before and after the treatment was also noted and recorded. In addition holes were bored into different parts of the treated portions of the poles, and the depth to which the preservative penetrated was closely observed.

Open-tank treatment.—Creosote was poured into the tank until the poles were covered for a distance of about 8 feet from the butt, and was then heated to a temperature above the boiling point of water. This temperature was maintained until the air in the wood had been expanded and the water in the outer layers vaporized, and both, so far as possible, driven out. * * * The preservative was then allowed to cool, thus producing a partial vacuum by the contraction of the air and the condensation of the steam remaining in the wood. The poles remained in the cooling liquid while the preservative, under atmospheric pressure, was forced into the wood. The entire time consumed by each treatment was about 24 hours, during which the temperature of the preservative was above the boiling point of water for 8 or 9 hours.

* * * Each pole was weighed before being put into the tank and again immediately upon being taken out. In this manner the amount of preservative absorbed was determined. No account could be taken of the amount of moisture driven out of the wood during the time the preservative was heated above the boiling point of water, and therefore the amount actually absorbed may be slightly greater than appeared from the weights. However, since the seasoned poles were practically air dry the determinations are probably very nearly correct. In the case of the green poles, on the other hand, it is probable that the actual absorption was considerably greater than that shown.

The preservatives used, method of application, and absorption secured are given in Table 1.[1]

PLACEMENT IN LINE.

Six hundred and thirteen treated poles, together with 551 untreated seasoned and green poles, were placed during August and September, 1905, in the line of the American Telephone & Telegraph Co., between Warren, Pa., and Buffalo, N. Y. This line extends at times along roadsides, and at others through cultivated fields, woodlots, and meadows, giving a variety of soil conditions. Table 2 shows the plan for setting the poles. Owing to difficulties in delivering the poles along the line, about 30 per cent were set with no definite plan. The number of poles of each kind is given in Table 3.

[1] The analyses of the preservatives used are given in the appendix to Bulletin 84.

TABLE 1.—*Method of treatment of poles set in Warren-Buffalo line.*

Condition when set.[1]	Preservative used, sold as—	Method of treatment.	Absorption secured per pole.		
			Average.	Maximum.	Minimum.
			Pounds.	*Pounds.*	*Pounds.*
Green		Untreated			
Seasoned		do			
Do	Coal tar	Brush, 1 coat			
Do	Creolin	do	3.39	4.13	2.88
Do	do	Brush, 2 coats	7.60	10.63	5.5
Do	Wood creosote	Brush, 1 coat	2.42	3.63	1.75
Do	do	Brush, 2 coats	5.43	6.63	3.25
Do	S. P. F. carbolineum	Brush, 1 coat	3.55	5.13	1.38
Do	do	Brush, 2 coats	4.38	6.63	3.0
Do	Avenarius carbolineum	Brush, 1 coat	1.98	2.25	1.13
Do	do	Brush, 2 coats	4.52	6.63	2.5
Do	Coal-tar creosote	do	7.77	11.75	4.13
Do	do	Open-tank	22.41	44.0	8.0
Green	do	do	15.20	39.0	4.0

[1] Describes also the condition at the time the treatment was applied.

TABLE 2.—*Plan of setting experimental poles in Warren-Buffalo line.*

No. of pole.	Condition when set.	Preservative used, sold as—	Method of treatment.
1	Seasoned	Avenarius carbolineum	Brush.
2	do		Untreated.
3	do	Avenarius carbolineum	Brush.
4	Green		Untreated.
5	Seasoned	S. P. F. carbolineum	Brush.
6	do		Untreated.
7	do	S. P. F. carbolineum	Brush.
8	Green		Untreated.
9	Seasoned	Coal-tar creosote	Brush.
10	do		Untreated.
11	do	Coal-tar creosote	Brush.
12	Green		Untreated.
13	Seasoned	Coal-tar creosote	Open-tank.
14	do		Untreated.
15	do	Coal-tar creosote	Open-tank.
16	Green		Untreated.
17	Seasoned	Wood creosote	Brush.
18	do		Untreated.
19	do	Wood creosote	Brush.
20	Green		Untreated.
21	Seasoned	Coal-tar creosote	Open-tank.
22	do		Untreated.
23	do	Coal-tar creosote	Open-tank.
24	Green		Untreated.
25	Seasoned	Creolin	Brush.
26	do		Untreated.
27	do	Creolin	Brush.
28	Green		Untreated.
29	Seasoned	Coal tar	Brush.
30	do		Untreated.
31	do	Coal tar	Brush.
32	Green		Untreated.
33	do	Coal-tar creosote	Open-tank.
34	Seasoned		Untreated.

The above series was repeated 24 times, series No. 2 beginning with pole No. 35, series No. 3 with pole No. 69, etc.

TABLE 3.—*Condition of experimental poles in Warren-Buffalo line after five years' service.*

Condition when set.	Description of poles.			Condition of poles at or near ground line.		
	Preservative used, sold as—	Method of treatment.	Number of poles.	Affected with decay.		Average loss in circumference at ground line.
				Number.	*Per cent.*	*Inches.*
Green		Untreated	194	194	100.0	1.16
Seasoned		do	357	355	99.4	1.01
Do	Coal tar	Brush—1 coat	48	47	98.0	.95
Do	Creolin	do	16	16	100.0	.89
Do	do	Brush—2 coats	63	44	69.8	.42
Do	Wood creosote	Brush—1 coat	21	20	95.2	.43
Do	do	Brush—2 coats	49	12	24.0	.06
Do	S. P. F. carbolineum	Brush—1 coat	10	3	30.0	.10
Do	do	Brush—2 coats	67	9	13.4	.04
Do	Avenarius carbolineum	Brush—1 coat	8	2	25.0	.27
Do	do	Brush—2 coats	66	9	13.6	.04
Do	Coal-tar creosote	do	83	12	14.5	.02
Green	do	Open tank	29	0	.0	.0
Seasoned	do	do	153	1	.65	Negligible.

METHOD OF INSPECTION.

Five years after placement the poles were inspected by representatives of the American Telephone & Telegraph Co., the Bureau of Entomology, and the Forest Service.[1] The method of inspection was as follows:

After the soil was removed from the base of each pole to a depth of from 6 inches to 1 foot the circumference was measured at or close to the ground line. Since this measurement was made to determine the original circumference of the pole, which, unfortunately, had not been measured when the poles were set, the proper point at which to take the measurement was carefully selected. If loss by decay impaired the accuracy of the measurement, proper allowance was made in the figures recorded.

After the first measurement the pole was carefully examined with hatchet and prod for decay or insect injury. Decayed portions of the poles, if of any extent, were removed with the hatchet, and a second measurement of circumference was then made at the point of greatest decay. This was usually found to be at or near the point selected for the first measurement. Poles which appeared to be unaffected by decay, but which rang hollow when struck with a hatchet, were bored to determine how far decay had actually progressed. After inspection creosoted plugs were driven into the holes and the soil which had been removed from about the poles was replaced.

[1] The members of the inspection party were: Mr. R. F. Hosford and Mr. C. E. Taylor, American Telephone & Telegraph Co.; Mr. T. E. Snyder, Bureau of Entomology, U. S. Department of Agriculture; and Mr. C. P. Winslow, Forest Service. Mr. Hosford and Mr. Snyder were present at the inspection of only some of the poles.

COMPUTATION OF DATA.

The per cent of each class of poles affected with decay at or near the ground line and the average loss of circumference at that point were computed. In most cases the latter could be determined by averaging for all poles in the class the differences between the two circumference measurements for each pole. Often, however, the extent and position of the decayed area were such that the two measurements showed no appreciable difference. In other cases decay in the treated zone was confined to cant-hook or other mechanical scars. For a fair comparison, therefore, it was necessary to make allowance for such conditions, and the following procedure was carried out:

(1) Where decay at or near the ground line was so situated that the measurements of circumference with and without the decayed portions showed little or no difference, an appropriate loss of circumference was assumed. This assumed loss was determined by the amount and situation of the decay according to tables of the American Telephone & Telegraph Company.

(2) For every pole showing signs of decay at the ground line a loss of circumference of one-eighth inch or more was recorded.

(3) In one set of computations those poles which showed decay due only to mechanical injury were considered as sound. The results, however, were so similar to those obtained when all poles which showed decay at the ground line were considered that only the latter ones are given.

CONDITION OF EXPERIMENTAL POLES.

Table 3 gives, for each class of poles, the per cent affected with decay and the average loss in circumference at the ground line. Figure 1 presents the same data in graphic form. The more significant results are summarized on page 12. For a proper valuation of these results the following points should be noted:

The comparatively small number of poles treated with only one coat of some of the preservatives renders the results in their case less conclusive than where two coats were used.

Analyses made by the American Telephone & Telegraph Co. of two samples of creolin showed a water content, respectively, of 20 and 90 per cent. So great a variation in composition must detract, of course, from the value of the test, so far as this preservative is concerned.

Aside from decay at the ground line, the condition of the experimental poles at the time of inspection was good. Many were slightly affected with sap rot in portions not influenced by soil moisture, and from some the outer fibers were peeling off. These trivial defects,

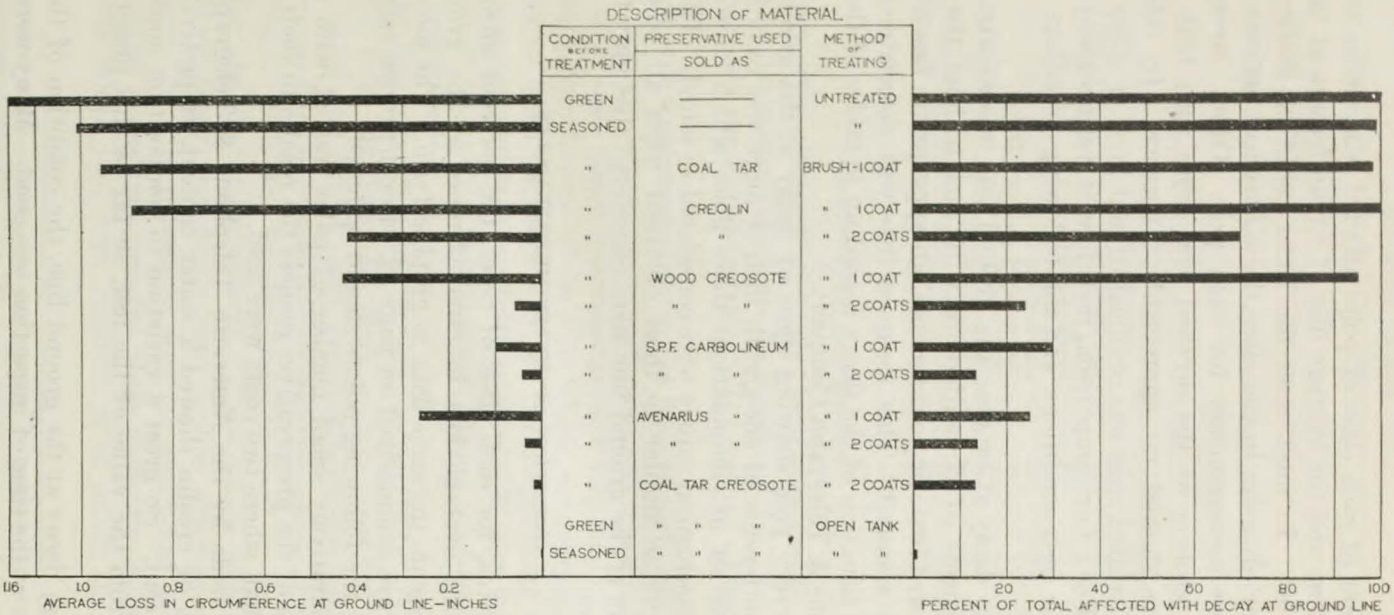

FIG. 1.—Condition of experimental poles in Warren-Buffalo line 5 years after placement.

however, were not influenced by the preservative. Decay in the treated zone rarely extended more than 6 inches above the ground line. Occasionally some was found in hollow knots above this point. Poles thus affected, however, are not included among those classed as showing decay. Insect damage to poles is discussed on page 13.[1]

EXPERIMENTAL POLES IN THE POUGHKEEPSIE-NEWTON SQUARE LINE.

The results from this experimental line are not as conclusive as those from the one just described. Only 72 poles were placed, and records showing the details of their preparation and treatment are not available. Table 4 gives the number of poles of each class and their average loss of circumference at the ground line. Figure 2 shows the same data in graphic form.

The poles were inspected in July, 1910, approximately eight years after placement.[2] In general the method of inspection was the same

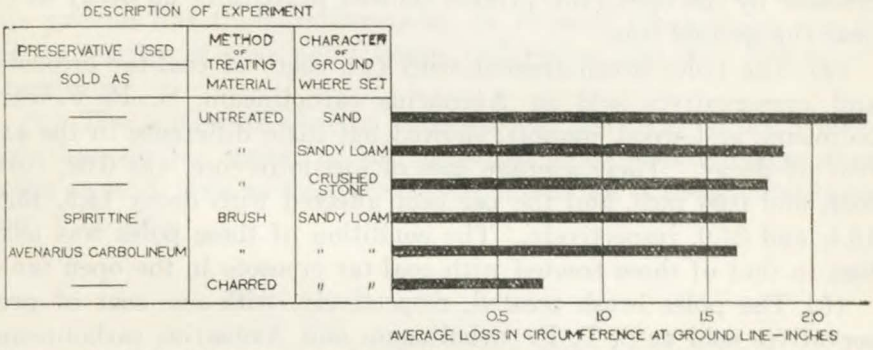

FIG. 2.—Condition of experimental poles in Poughkeepsie-Newton Square line 8 years after placement.

as that for the Warren-Buffalo line, except that the decayed portions near the ground line were first removed after which three circumference measurements were made, one 5 feet above the ground line, one 6 inches above, and one 6 inches below. To compute the average loss in circumference at the ground line the average taper per linear foot was obtained by dividing the difference between the circumference 5 feet above the ground line and that 6 inches above by 4.5, and the result added to the difference between the circumference 6 inches above the ground line and that 6 inches below.

[1] Notes on damage by insects to the poles in this and the Poughkeepsie-Newton Square line are given in Bureau of Entomology Bulletin 94, Part I, "Damage to Chestnut Telephone and Telegraph Poles by Wood-Boring Insects," by T. E. Snyder. Further information regarding damage to poles by insects is contained in Bureau of Entomology Circular 134, "Damage to Telephone and Telegraph Poles by Wood-Boring Insects," by the same author.

[2] The inspection was made by Messrs. R. F. Hosford, F. O. Mackey, A. W. May, and H. G. Spohr for the American Telephone & Telegraph Company, Mr. T. E. Snyder for the Bureau of Entomology, United States Department of Agriculture, and Mr. H. F. Weiss for the Forest Service.

TABLE 4.—*Description of poles set in the Poughkeepsie-Newton Square line and their average loss in circumference at ground line after eight years' service.*

Total number of poles.	Preservative used, sold as—	Method of treating.	Character of ground in which set.	Average loss in circumference at ground line.
				Inches.
10		Untreated	Sand	2.27
28		do	Sandy loam	1.87
8		do	Crushed stone	1.77
11	Spirittine	Brush	Sandy loam	1.68
10	Avenarius carbolineum	do	do	1.63
5		Charred	do	0.71

SUMMARY OF RESULTS OF INSPECTION OF EXPERIMENTAL POLES.

POLES IN WARREN-BUFFALO LINE.

(1) Both the green and seasoned poles butt-treated with coal-tar creosote by the open-tank process showed practically no decay at or near the ground line.

(2) The poles brush treated with two coats of coal-tar creosote, and preservatives sold as Avenarius carbolineum, S. P. F. carbolineum, and wood creosote, showed but little difference in the extent of decay. Their average loss of circumference was 0.02, 0.04, 0.04, and 0.06 inch, and the per cent affected with decay 14.5, 13.6, 13.4, and 24.0, respectively. The condition of these poles was next best to that of those treated with coal-tar creosote in the open tank.

(3) The poles brush treated, respectively, with one coat of preservatives sold as S. P. F. carbolineum and Avenarius carbolineum showed a much greater loss of circumference at the ground line than those treated with two coats of these preservatives. The average losses of circumference were 0.10 inch and 0.27 inch, and the per cent affected with decay 30 and 25, respectively.

(4) The poles brush treated with two coats of preservative sold as creolin and those similarly treated with one coat of preservative sold as wood creosote showed but slight difference in loss of circumference at the ground line, the average loss being 0.42 and 0.43 inch, and the per cent affected with decay 69.8 and 95.2, respectively.

(5) The poles brush treated, respectively, with one coat of preservatives sold as creolin and coal tar, showed a loss of circumference at the ground line of 0.89 and 0.95 inch, and a per cent affected with decay of 100 and 98, respectively. The loss with these poles was nearly as great as with the untreated.

(6) The untreated poles were practically all more or less affected with decay at the ground line, the average loss of circumference for those seasoned prior to placement being 1.01 inches, and for those placed green 1.16 inches. That two of those seasoned prior to place-

ment showed no decay at or near the ground line is possibly due to the fact that they were both set on a hillside or slope where the drainage was excellent. One of them was set in broken stone and rock.

(7) The reference in Bureau of Entomology Bulletin 94, Part I, pages 9–10, to insect damage to poles in this line is as follows:

> All these treatments, except the brush treatments with creolin and tar, were efficient in preventing the attacks of wood-boring insects, at least for a five-year period, in this northern climate. There was but little damage by insects to the poles in this test line. The most common injury to the untreated poles was by the large black carpenter ants which widen the longitudinal weathering checks, and hence induce more rapid decay. The work of the chestnut telephone-pole borer was found in several poles, and this beetle was evidently just beginning to attack these poles.

POLES IN POUGHKEEPSIE-NEWTON SQUARE LINE.

(1) The untreated poles set in crushed stone showed less decay at the ground line than similar poles set in sand, the average loss of circumference at that point being 1.77 inches and 2.27 inches, respectively.

(2) The poles with charred butts showed less decay at the ground line than similar uncharred and untreated poles set in either crushed stone or sand, their average loss in circumference at the ground being only 0.71 inch.

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